THE PRE-EURO-AMERICAN VEGETATION COVER SURROUNDING WISCONSIN'S DEEPEST INLAND NATURAL LAKE

Thomas L. Eddy
426 Walker Avenue
Green Lake, Wisconsin 54941
thomasleoeddy@gmail.com

ABSTRACT

The interior section lines from the early land survey records c. 1830 were examined to identify and quantify the pre-Euro-American settlement vegetation cover in the four survey townships surrounding Green Lake, Wisconsin. A main emphasis of this paper is on the presence of oak savanna communities prior to early settlement. In addition to the field notes data, historical narratives that include eyewitness accounts characterize the vegetation cover as oak savanna, with open woodlands and oak openings as prevalent communities surrounding Green Lake.

KEYWORDS: Green Lake, Euro-American, presettlement, oak savanna, survey field notes

INTRODUCTION

Green Lake, Wisconsin's deepest inland natural lake, is located in Green Lake County approximately 70 miles northeast of Madison. The mostly rural landscape surrounding Green Lake includes roads, farm fields, pastures, various businesses (manufacturing, convenience stores, restaurants, motels), private residences, golf courses, stone/gravel quarries, oak woodlands, wetlands and lake tributaries, city and county parks, and conservancy properties.

The City of Green Lake (43.845207, –88.960131), the county seat of Green Lake County, is a popular tourist and recreational destination located in east central Wisconsin. The city of 1,101 people is located along the northeast shore where the lake's outlet, the Puchyan River, begins, which then flows eventually into the Fox River.

Green Lake formed in an ancient preglacial river valley approximately 12,000 years BP after the west end was dammed by deposition of outwash and glacial terminal moraines (Martin 1965; Hooyer et al. 2021). Classified as a drainage lake, Green Lake is 236 feet deep and covering an area of 7,920 acres (Wisconsin DNR 2023a). The lake is 7.3 miles long and two miles at its greatest width. The 27.3 miles of diverse shoreline, parts of which remain undeveloped, varies from prominent exposed sandstone and dolomitic bluffs and steep slopes to terraces, ravines, and rolling hills.

In a late nineteenth century lithograph entitled "Birds Eye View of Green Lake Wis. 1875" by George L. Richards, a draftsman and publisher of panoramic views during the 1870s, most of the Green Lake shoreland is depicted as closed canopy deciduous forest (Figure 1). The bucolic scene reveals a panoramic aer-

ial view from the south side of the lake looking north, complete with fishing boats, sailboats, and steamers plying the water.

This "birds eye view" of Green Lake, surrounded by forested shoreland, is not what the Ho-Chunk tribe experienced as long-time inhabitants of the region, nor later by the early pioneers and settlers on their arrival at Green Lake in the early to mid-nineteenth century. The evidence supports the view of a vegetation cover prior to settlement that was dominated by oak savanna with communities of open oak woodlands, oak openings, and small tracts of upland oak forest surrounding Green Lake (Wisconsin DNR 2017a). An oak savanna landscape was frequently referred to by early settlers whose land claims were established within the four survey townships surrounding Green Lake (Dart 1910; Gillespy 1860).

Green Lake County is located slightly below Wisconsin's tension zone, a transition zone between two floristic provinces, the northern hardwood province and the prairie-forest province (Curtis 1959). At the time of early Euro-American settlement the prairie-forest province was dominated by oak savannas and open oak woodlands (Cochrane & Iltis 2000). According to Leach and Givnish (1999), oak savannas in aggregate were the most widespread communities in southern Wisconsin, occupying approximately 42% of the land area below the tension zone.

Two geographical provinces are represented in Green Lake County based upon the underlying bedrock, Cambrian sandstone and Ordovician dolomite (Martin 1965). The Central Plain occupies the western and northwestern portions of the county, while the Eastern Ridges and Lowlands represent a slightly larger area to the east. Green Lake and part of its surrounding watershed reside in both of these geographical provinces.

Four soil associations are present in the survey townships surrounding Green Lake (USDA 1977). Of these, two soil associations comprise most of the study area. The Plano-Mendota–St. Charles association consists of soils that are found on the uplands south of Green Lake where prairie and oak openings were present. The soils are well drained, nearly level to sloping soils that have a subsoil mainly of silt loam and silty clay. The Kidder–Rotamer–Grellton association is found on steeper slopes mainly north of Green Lake where open oak woodlands and oak openings were established. Bur oak was especially prevalent on the loamy outwash sands of the Boyer–Oshtemo–Gotham association at the west end of the lake. Wetlands that include marsh and sedge meadows consist of level and poorly drained organic soils of the Adrian–Houghton association.

The Wisconsin Department of Natural Resources recognizes 16 ecoregions in Wisconsin, areas defined by environmental conditions, e.g., climate, landforms, and soil characteristics (Wisconsin DNR 2023b). Of these, most of Green Lake County (73%) belongs in the Central Sand Hills region where landform features include glacial moraines that are covered by glacial outwash. Historically, over 75% of the vegetative cover of the Central Sand Hills was comprised of forest, woodland, and savanna communities (Finley 1976).

Smaller areas in the northern and eastern portions of the county (27%) are part of the Southeast Glacial Plains where a thick layer of glacial deposits is mainly underlain by limestone, dolomite, and sandstone. The vegetation cover in the mid-1800s included forest, savanna, and prairie, combined with various wet-

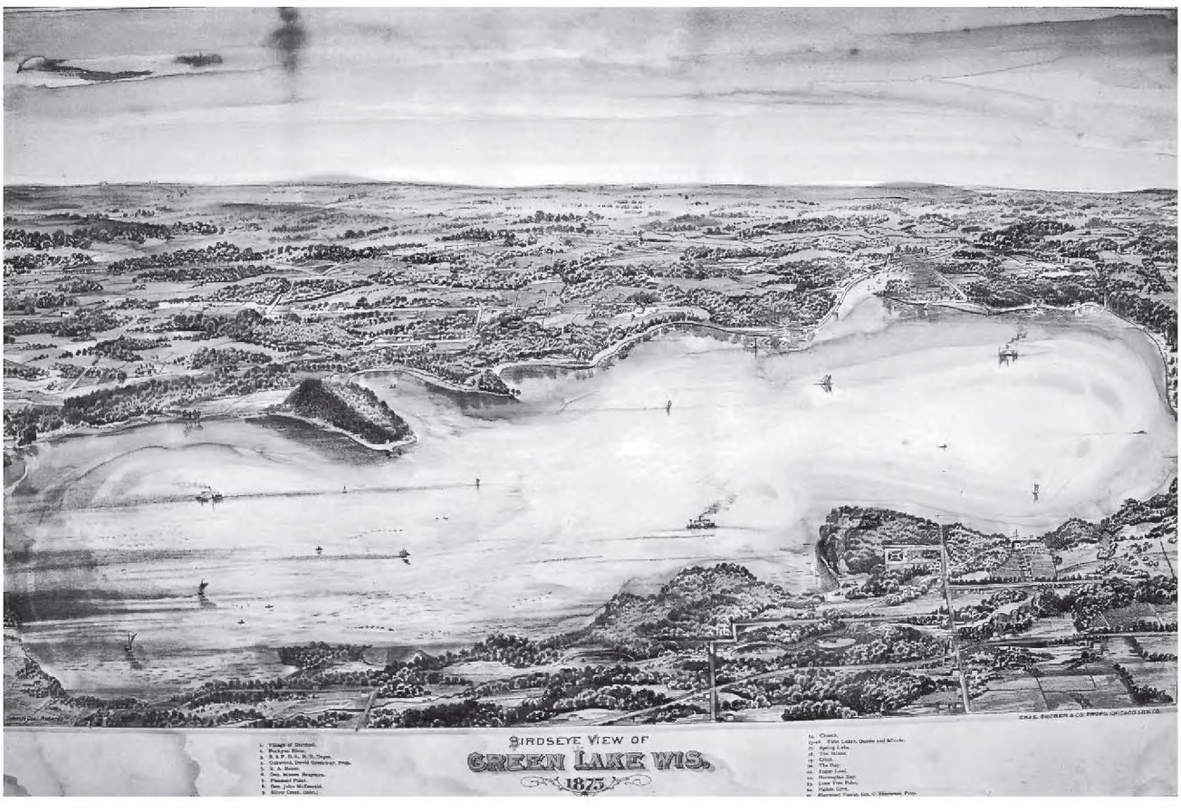

FIGURE 1. Panoramic view of Green Lake, Wisconsin from a late 19th century lithograph entitled "BIRDSEYE VIEW OF GREEN LAKE OF GREEN LAKE WIS. 1875." Author's lithograph copy.

lands (Finley 1976). Green Lake and the surrounding watershed occupy both of these ecoregions.

A primary objective of this study was to examine the original land survey field notes c.1830 for the four survey townships surrounding Green Lake (Figure 2). Tree species data that was recorded along interior section lines were tabulated to quantify and interpret the vegetation cover prior to early Euro-American settlement. The study results also offer a contrast between the original vegetation cover within the four survey townships with that of present-day vegetation patterns brought about by the accompanying land use changes.

In addition to the field notes, a further understanding of the vegetation cover prior to settlement reported by other sources provides a more comprehensive interpretation of the vegetation cover (Dart 1910; Finley 1976; Gillespy 1860; Leach and Givnish 1999; Tans 1976). Practical application of this information is used toward native habitat restoration efforts for several locally protected conservancy lands that previously had been developed or degraded natural areas, e.g., Tichora Conservancy, Green Lake Township, NE ¼ Section 12, T15N, R12E (43.790646, –89.012230), Tuleta Hill Prairie Conservancy, Green Lake Township, NW ¼ Section 5, T16N, R13E (43.808425, –88.983004), Norwegian Bay Conservancy, Brooklyn Township, Section 35, T16N, R12E (43.812111, –89.043472), Sunnyside Conservancy, Brooklyn Township, SW ¼, Section 23, T16N, R13E (43.838985, –88.924597) and Winnebago Trail Conservancy, Brooklyn Township, Section 36, T16N, R12E (43.814991, –89.025834).

MATERIALS AND METHODS

Early Land Survey Field Notes

The original survey field notes recorded by the early land surveyors may provide the most comprehensive record of the pre-Euro-American vegetation cover. The original surveyors' field notes are made available online by the Wisconsin Board of Commissioners of Public Lands (2023). The descriptions of the surveys and the techniques used that are recounted below are taken from the same source. The Public Land Survey System was created under the Land Ordinance of 1785, which was enacted into law by the United States Congress under the Articles of Confederation. The survey was conducted by the federal General Land Office, which was created by Congress in 1812, and is founded on the township, range and section grid upon which legal land ownership and land use is based on.

Surveys in what is now Wisconsin took place between 1832 and 1865, although surveys in a few townships with Indian reservations were not completed until later in the century (Sickley et al. 2000). Schulte and Mladenoff (2001) explained that the Public Land Survey records "generally provide their best description of presettlement vegetation when used in a relative way, analyzed over broad spatial extents and at coarse spatial resolutions, and used in conjunction with other historical data sources."

The early land surveyors were instructed to record the location of the quarter and corner sections, the name and diameter of each bearing tree, as well as its compass bearing and the distance from the quarter and corner sections. Wherever possible, line trees that intersected section lines were recorded. Treeless habitats such as prairie and marshes required earthen mounds of soil or stone to mark the location of the corners. Wooden posts, approximately four inches square and two feet tall, were positioned at section and quarter-section corners that were near to at least two bearing trees. Survey posts were marked with the township, range, and section numbers.

Measurements were obtained by using chains and links, in which one 66-foot chain consisted of 100 links and each link equaled 7.92 inches. Eighty chains are one mile. For example, the entry for T16N R13E, "South Between sections 27 & 28 3.28 [3 chains and 28 links] White oak 8," is understood to mean that a white oak eight inches in diameter occurs 216.48 feet south of where sections 21, 22, 27 and 28 intersect.

The study area included the four survey townships surrounding Green Lake where the interior section lines from the field notes were examined to quantify tree data (Figure 2). According to the Public Land Survey System which is accessible online, the government land surveys for Green Lake County were conducted from 1834 to 1835 and in 1851. The survey townships (abbreviated names used here referring to the township direction relative to Green Lake in parentheses) of T15N R13E (SE Lake) and T16N R13E (NE Lake) were surveyed in 1834 and 1835, while those of T15N R12E (SW Lake) and T16N R12E (NW Lake) were completed in 1851.

The four present-day civil townships bordering Green Lake roughly correspond to the four survey townships. Unlike a 36 square miles survey township, a civil township delineates the units of local government surrounding Green Lake and include the townships of Green Lake, Brooklyn, Marquette, and Princeton (Figure 3).

The field notes data that were compiled and summarized include the identification of line and bearing trees, the mean distance in links from the quarter and corner section posts to bearing trees, tree diameters and class size distribution of trees intersecting section lines, and a calculation of the number of trees per acre and canopy cover for each survey township.

The method of calculating the density of trees per acre is equal to [43,560 square feet per acre]/d^2 where d is the average distance between the sample point and all the bearing trees associated with the sample point (Cottam and Curtis 1956). The canopy cover was determined by using a 50% canopy cover in oak savannas equivalent to 19 trees per acre (Anderson and Anderson 1975).

Literature Survey

Published floras based on field observations and collected specimen vouchers housed in the Neil A. Harriman Herbarium (OSH) at University of Wisconsin-Oshkosh were examined to provide a more comprehensive knowledge of the early vegetation cover for the area (see, e.g., Eddy 1996, 1999, 2001, 2005).

Nomenclature follows the Online Virtual Flora of Wisconsin (2023), which in turn is based on a

number of sources, including Voss and Reznicek (2012), the latest Flora of North America volumes, and recent monographs (Dr. Mary Ann Feist, personal communication).

Township, range and section are used to identify the place locations that are referred to on and nearby Green Lake (Rockford Map Publishers 2019). The same sites are also georeferenced in decimal degrees by means of Google Maps (2023) and the android/mac app onX Maps (2023).

Online literature searches via Google Scholar were conducted to identify sources that provided a broader overview of the original pre-Euro-American presettlement vegetation cover c.1830 throughout the southern half of Wisconsin and to the extent possible, most proximate to Green Lake County.

A map of the original vegetation cover for Green Lake County (Figure 4) was prepared by the Green Lake County Land Use Planning and Zoning Department (2023) using the Wisconsin DNR's original vegetation polygon layer derived from a 1:500,000-scale map prepared by Robert W. Finley (Wisconsin DNR 2017a). Seven different polygons represent the county's different plant community types along with a hydrographic area polygon.

Historical Accounts

Historical narratives and eyewitness accounts include (i) a letter dated August 28, 1854 by Julia Peck Sherwood, wife of pioneer William Case Sherwood, written to her sister Harriet Sage and family (original letter loaned by Clarence F. Busse); (ii) letters written by S. D. Mitchell and catalogued by the State Historical Society of Wisconsin's archaeological collection from Green Lake and Marquette counties Wisconsin (Archives Division, Register of the Charles E. Brown Papers, 1889–1946, Box 26 Folder 1); (iii) anecdotes "as related by old pioneers" reported by Gillespy (1860) in his publication "The History of Green Lake County"; and (iv) a historical narrative, titled "Settlement of Green Lake County" (Dart 1910), prepared by Richard Dart, who was 12 years old in 1840 when Dart, his father, Anson Dart, and two brothers, Charles and Putnam, arrived and settled near Green Lake.

RESULTS AND DISCUSSION

Curtis (1959) distinguished three main types of oak savanna based on canopy composition and substrate: oak openings, oak barrens, and lowland oak savanna (Figure 5). Oak savanna was the most widespread vegetation cover throughout Green Lake County, occupying loamy soils on uplands, slopes, and sandy terraces (USDA 1977; Wisconsin DNR 2017a). Plant communities would have included tracts of oak forest, open oak woodlands, oak openings, prairie, and various wetlands (Finley 1976).

In addition to oak savanna there was a disjunct area of sugar maple–basswood forest near the southeast end of Green Lake, as well as an isolated stand of red and white pine forest north of Lake Puckaway.

An extensive oak savanna complex was present on the two low-relief dolomitic escarpments formed by the Prairie du Chien Group located on the north and south sides of Green Lake and the Sinnipee Group located on the south side (Martin 1965; Hooyer et al. 2021). The area surrounding Green Lake was thinly timbered with oak woodlands, oak openings, and, to a lesser extent, occasional small tracts of oak forest. On the uplands south of the lake, dry to mesic prairies merged with oak savanna, while wetlands and lake tributaries occupied the lowlands surrounding Green Lake. Lake Puckaway and the Fox River are located west of Green Lake, while Big Twin and Little Twin Lakes, Spring Lake, and Little Green Lake lie to the south.

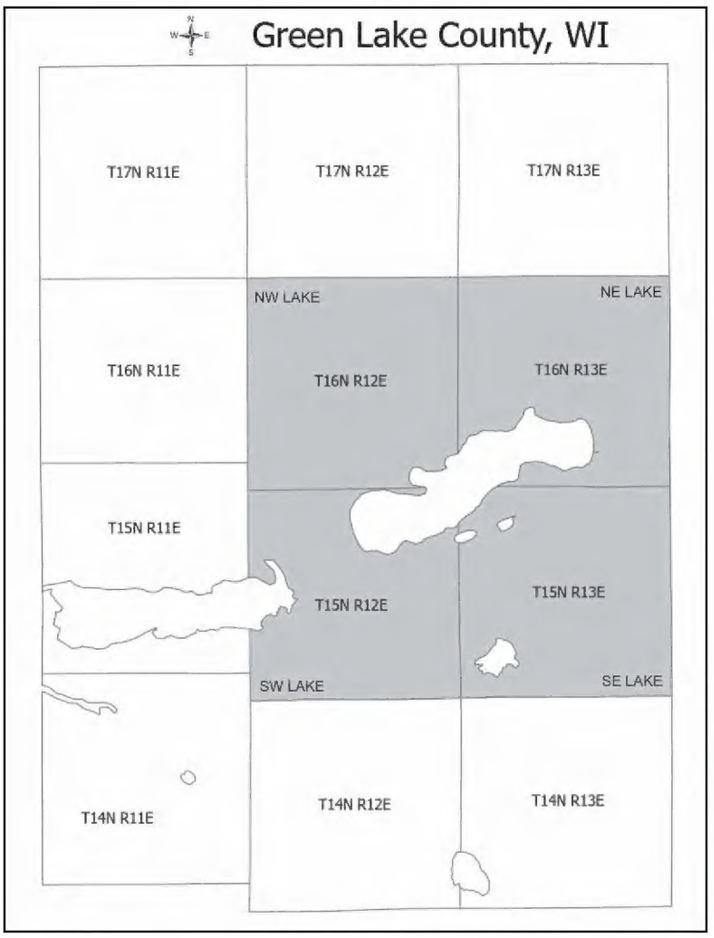

FIGURE 2. A map of the study area, the four survey townships (shaded) surrounding Green Lake. The interior section lines from the field notes were examined to quantify tree data for the four survey townships (Green Lake County Land Use Planning and Zoning Department 2023).

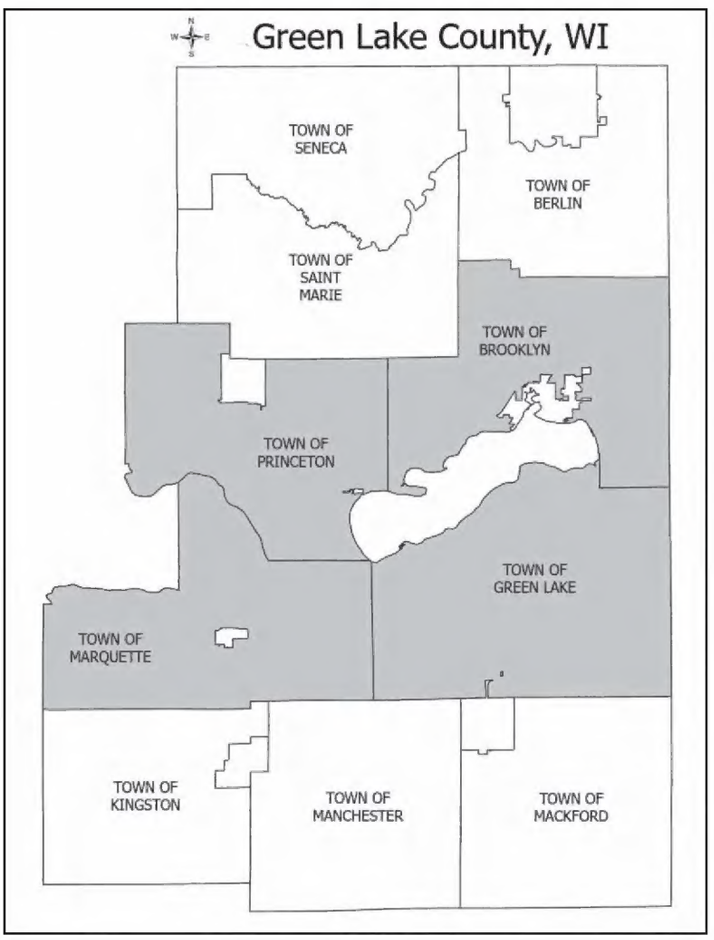

FIGURE 3. A map of the four present-day civil townships (shaded) that delineate the units of local government surrounding Green Lake and include the townships of Green Lake, Brooklyn, Marquette, and Princeton. The civil townships roughly correspond to the survey townships (Green Lake County Land Use Planning and Zoning Department 2023).

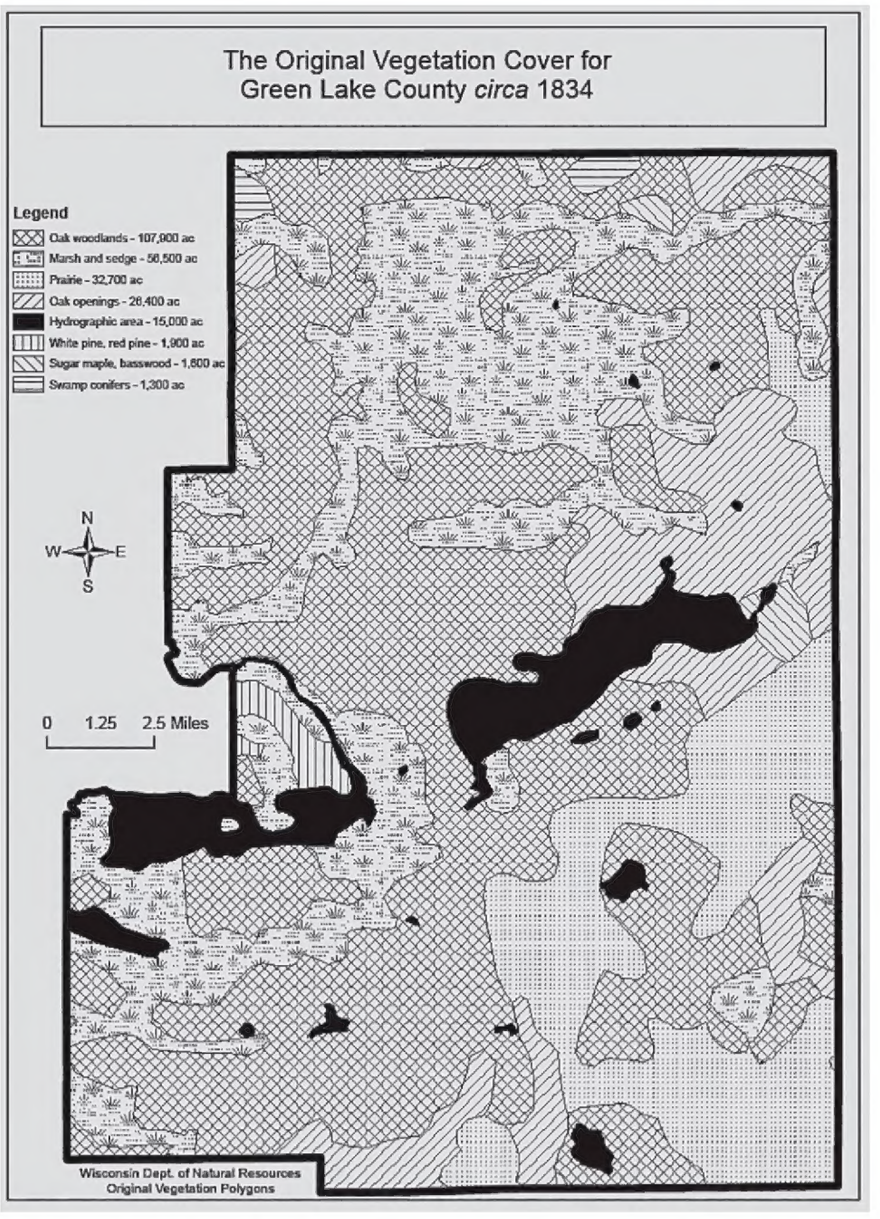

FIGURE 4. A map of the original vegetation cover for Green Lake County prepared by the Green Lake County Land Use Planning and Zoning Department and based on the Wisconsin DNR's original vegetation polygons (Green Lake County Land Use Planning and Zoning Department 2023; Wisconsin DNR 2023).

Survey Records

The prevalence of oak savanna extends beyond the four survey townships surrounding Green Lake. Oak woodlands and oak openings accounted for a combined 58.9% of the total original vegetation cover in the county (Table 1). Oak woodlands represent the largest acreage with 107,900 acres, while oak openings accounted for 24,600 acres. Where the canopy was one-half or more open, surveyors frequently recorded the vegetation density qualitatively as "thinly timbered" or "scattering", descriptive of the oak savanna transition from grassland to forest. Because the field notes do not consistently note the spacing

between trees, it is possible that areas of what had been mapped as oak forest may have been in fact open woodlands and oak openings (Finley 1976).

In the four survey townships that were examined, survey section lines intersected with 17 species of trees (Table 2). Three species of *Quercus* account for 92% of the total number of trees recorded as line and bearing trees. These include *Q. velutina*, 24.5%; *Q. alba*, 31.9%; and *Q. macrocarpa*, 35.6%.

The field notes do not contain any records for northern red oak (*Q. rubra*) in any of the four townships examined. The species is, however, documented in every Wisconsin county except Shawano County, and it is not uncommon in Green Lake County (Online Virtual Flora of Wisconsin 2024). Likewise, Tans (1976) did not report any northern red oak recorded in the original survey field notes for Columbia County, bordering Green Lake County to the south.

Trees in three genera are identified in the field notes to genus only: *Populus, Ulmus*, and *Salix*. The field notes record "Aspen," which refers to *Populus tremuloides* or *P. grandidentata*; "Elm" and "White elm" which probably refers to *Ulmus rubra* and *U. americana,* respectively; and "Willow," which could refer to any number of native, larger diameter *Salix* species. Given the same area and wet habitat as black ash (*Fraxinus nigra*), it is probable that green ash (*Fraxinus pennsylvanica*) was misidentified as white ash (*Fraxinus americana*), which is not documented for Green Lake County.

Tallgrass prairie occupied 32,700 acres on the uplands south of Green Lake (Green Lake County Land Use Planning and Zoning Department 2023). The field notes for SE LAKE and SW LAKE contain 44 entries of "Prairie" as line and bearing points. In the notes for SE LAKE, an entry for a corner section stated "Set post corner to sections 23 24 25 26 Made a mound of Earth and sods 3 feet square at base & 3 feet high Land rolling second rate South part thinly timbered with Blk W & Bur oak North part prairie." Another entry states "Set post corner to sections 11 12 13 14 in prairie Made a mound Land rolling good prairie."

Elsewhere where the loamy clay topsoil was thin, the field notes provided a brief description: "Land rolling second rate dry prairie." Occasionally specific prairie flora was recorded, as for example: "Prairie level second rate Red root [also named New Jersey tea, *Ceanothus americanus* L.] rosin-weed [*Silphium integrifolium* Michx.] rose [*Rosa* spp.] willow [*Salix* spp.] etc."

Trees were also scarce in certain wetlands in the four survey townships surrounding Green Lake. The field notes record 17 entries identified as "Marsh." Marsh and sedge meadow, as along with other wetland communities, occupied 56,500 acres throughout the county's Central Plain, with the majority of the acres associated with the Fox River, Lake Puckaway, and the White River Marsh Wildlife Area. Major wetlands immediately adjacent to Green Lake included areas of Silver Creek (Sections 23, 24 & 26 T16N R13E), Norwegian Bay (Sections 35 & 36 T16N R12E), and Dodge Memorial County Park (E ½ Section 15 T15N R12E).

Marsh and swamp habitats were associated with Green Lake's main tributary, Silver Creek, on the east end of the lake. In SE LAKE between sections 13 and 24, the field notes states "Set quarter section post in marsh no trees too wet for mound." The field notes summarized the area where the post corner was placed

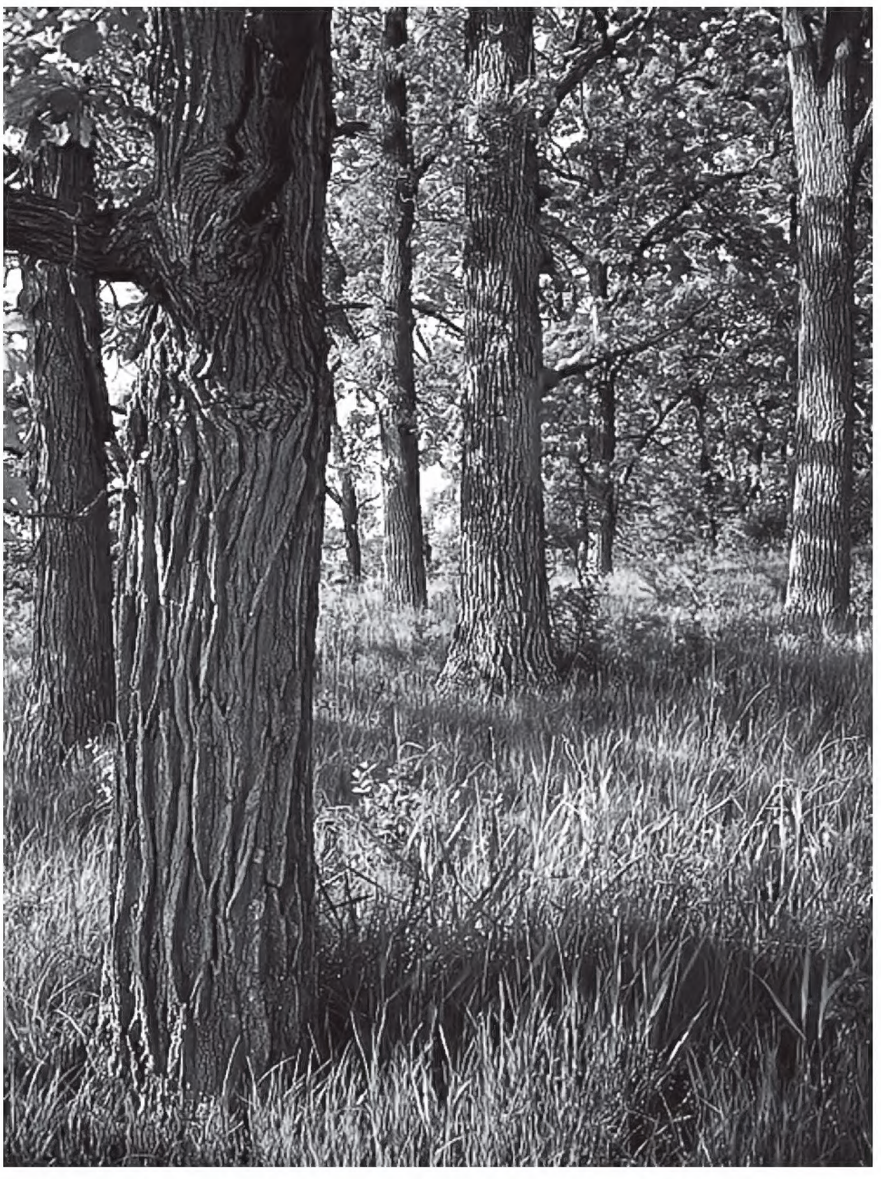

FIGURE 5. A remnant bur oak opening near the east end of Green Lake. Note the spacing of trees, open canopy, and sunlit ground cover. Photo by the author.

TABLE 1. The pre-Euro-American presettlement vegetation cover in Green Lake County. Map prepared by Green Lake County Land Use Planning and Zoning Department (2023).

Vegetation Cover Type	Acres	Percentage of County
Oak woodland	107,900	47.3
Oak opening	26,400	11.6
Prairie	32,700	14.3
Marsh and sedge meadow	56,500	24.7
White pine, red pine	1,900	0.83
Sugar maple, basswood	1,600	0.70
Swamp conifer (tamarack)	1,300	0.57
Totals	228,300	100

TABLE 2. Summary of trees intersected by the interior survey lines during the original land survey for the four townships surrounding Green Lake (T15N R12E – SW LAKE, T15N R13E – SE LAKE, T16N R12E – NW LAKE, T16N R13E – NE LAKE) (Wisconsin Board of Commissioners of Public Lands 2023).

Common Name	Scientific Name	No. of Trees	% of Total
B. Oak, Blk. Oak	*Quercus velutina* Lam.	193	24.5
W. Oak	*Quercus alba* L.	252	31.9
Bur Oak	*Quercus macrocarpa* Michx.	281	35.6
Aspen	*Populus* spp.	8	1.0
Elm, white elm	*Ulmus* spp.	6	0.76
B. Ash, Black Ash	*Fraxinus nigra* Marshall	10	1.3
W. Ash, White Ash	*Fraxinus americana* L.	3	0.38
Sugar Maple	*Acer saccharum* Marshall	1	0.13
Lynn [Basswood]	*Tilia americana* L.	4	0.51
Butternut	*Juglans cinerea* L.	1	0.13
Hicky [Hickory]	*Carya ovata* (Mill.) K. Koch	2	0.25
Cherry [Black cherry]	*Prunus serotina* Ehrh.	1	0.13
Willow	*Salix* spp.	3	0.38
Iron wood [Ironwood]	*Ostrya virginiana* (Mill.) K. Koch	1	0.13
Red Cedar	*Juniperus virginiana* L.	1	0.13
Hasel [American hazelnut]	*Corylus americana* Walter	2	0.25
Tamk [Tamarack]	*Larix laricina* (Du Roi) K. Koch	20	2.5
Totals		789	100

at sections 22 23 26 27: "Land first part swamp. Last part except marsh rolling second rate thinly timbered with W B & Bur oak." Trees recorded in swamp areas included black ash (*Fraxinus nigra*), white ash (probably green ash, *F. pennsylvanica*), aspen (probably quaking aspen, *Populus tremuloides*), elm (probably red or slippery elm, *Ulmus rubra*) and willow (*Salix* spp.).

For the area west of Green Lake near Lake Puckaway and the Fox River, in SW LAKE between sections 16 & 17, we read this: "Set quarter section post in marsh no trees" and "Set corner sections 8 9 16 17 in marsh Tamk [Tamarack, *Larix laricina*] 14 [tree diameter] S65E [compass bearing] 7.74 [774 links] no other [trees]." Willow (*Salix* spp.) and aspen (*P. tremuloides*) were also recorded. A brief summary description following a quarter section post placed between sections 29 and 30 noted: "Land level marsh Grasses Bushes Flaggs [blue flag, *Iris versicolor* L. and/or *I. virginica* L.]."

In a study of the presettlement vegetation of Columbia County, Tans (1976) suggested that "It is probable that the surveyors selected oaks more often as bearing trees, and it is likely, too, that the oak forests were simply oak savannas which had become closed communities by growth of root sprouts in the absence of regular fires; they represented an early successional stage of forests." This assessment is consistent with early anecdotal observations (Gillespy 1860; Sherwood 1854).

The size class distribution of the 776 line and bearing recorded during the original survey for the four townships surrounding Green Lake shows that the median size tree was in the 14–16-inch size class (Figure 6). The mean diameter

of the black, white, and bur oaks combined for the four townships was 13-inches.

In township SW LAKE, along the southwest and west sides of the lake, 87 interior line and bearing trees were recorded for *Q. macrocarpa*, or 51% among the three oak species recorded. *Q. macrocarpa* is a reliable indicator for the presence of oak openings (Table 3). Aldo Leopold (1949) wrote in his "Bur Oak" essay for April from "A Sand County Almanac," "Most of these groves of scattered veterans, known to the pioneers as 'oak openings,' consisted of bur oaks." In comparison, for all Columbia County townships, oak openings were dominated by bur oak with 63–64% of the trees in the community (Tans 1976).

The ratios for the three species, black oak to white oak to bur oak, for the survey townships bordering Green Lake are: SW LAKE 1:1:4; SE LAKE 1:2:2; NW LAKE 1:1:1; and NE LAKE 1:2:2. In comparison to bur oak dominance in SW LAKE, oak savanna is most homogeneous in SW LAKE along the northwest side of the lake, with *Q. alba*, *Q. macrocarpa* and *Q. velutina* each represented by 33% of the total oaks.

The number of section corner and quarter samples, the mean number of links from post to tree, and the mean number of trees per acre for each of the four survey townships surrounding Green Lake are summarized in Table 4. The mean links from post to tree for townships SW LAKE (189 links) and SE LAKE (159) included one and two trees per acre, respectively. The canopy cover varied from 3% to 5% between the two townships.

The mean links from post to tree for townships NW LAKE (102 links) and SE LAKE (102 links) each included five trees per acre with a canopy cover of 13%. With a selection bias by surveyors for oaks used as bearing trees notwithstanding (Tans 1976), it is apparent that the vegetation cover in the townships surrounding Green Lake during the early survey was mostly open and thinly timbered oak savanna.

Depending upon soil substrate and moisture content, the canopy cover of oak openings and open woodlands would have ranged from a widely used criteria of 5%–30% or 5%–50%, thus representing a successional continuum from prairie to forest (Henderson and Epstein 1995). Cochrane and Iltis (2000) stated that a more contemporary definition of oak savannas used by ecologists are communities dominated by oaks with a mean canopy of more than 10% but less than 80%. The ground layer would have included grasses and sedges associated with mesic to dry prairies, but were largely forb-dominated, except in very sandy soils or in microhabitats with the greatest sun exposure (Leach and Givnish 1999).

Oak savannas are remarkably diverse. At small and larger spatial scales, the ground layer diversity of oak savannas exceeds that of prairies and forests (Leach and Givnish 1999). A floristic survey of 22 oak savanna remnants by Leach and Givnish (1999) reported 507 native plant species, or about 27% of the 1,873 species (Dr. John Zaborsky, personal communication) in Wisconsin's native vascular flora (Spalink et al. 2018).

From the Wisconsin Plant Ecology Laboratory studies completed during the 1940s and 1950s, data from original point samples of various plant communities were used to assess how changes in the surrounding landscape affected the floristic composition (Curtis 1959). A set of 47 species prevalent in oak openings

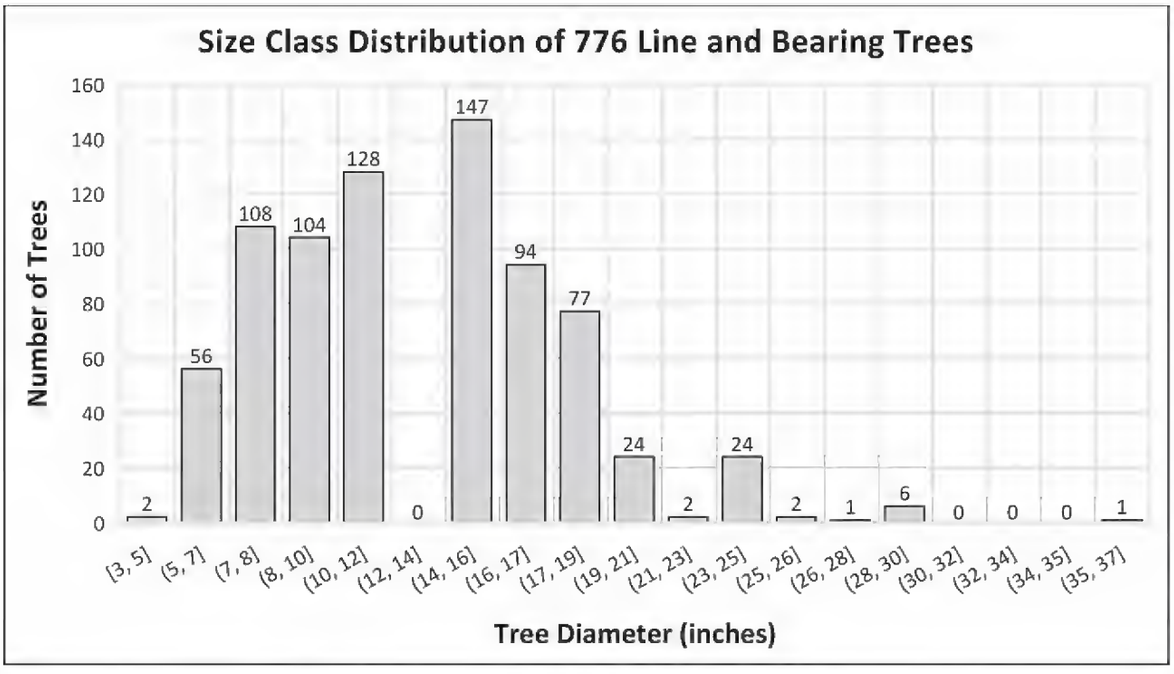

FIGURE 6. Average diameter of trees intersected by interior line and bearing trees for the four survey townships surrounding Green Lake. Data obtained from the original survey field notes (Wisconsin Board of Commissioners of Public Lands 2023).

and their mean frequencies are listed by Curtis (1959). All 47 species have been documented to occur in Green Lake County (Eddy 1996, 2018), including three modal species whose occurrence are greater in oak openings than in any other Wisconsin plant community (Curtis 1959). These modal species are *Heliopsis helianthoides* (L.) Sweet, *Ranunculus fascicularis* Muhl. ex J.M. Bigelow, and *Anticlea elegans* (Pursh) Rydb. (synonym *Zigadenus elegans* (Pursh) Rydb.).

Prior to Euro-American settlement, oak savannas in southern Wisconsin accounted for approximately 5.5 million acres (Curtis 1959). Fire disturbance caused by lightning strikes and human activities are estimated to have occurred at 1–10-year intervals, maintaining a dynamic oak savanna ecology (Abrams 1992). By the latter half of the nineteenth century, the implementation of intensive agriculture, overgrazing, fire suppression, invasion of weedy native plants and aggressive exotics, and habitat fragmentation reduced the amount of intact remnant oak savanna that is reported as extant in the Wisconsin State Natural Heritage Inventory to approximately 500 acres of the original 5.5 million acres, or a mere 0.01% currently remaining (Henderson and Epstein 1995).

Curtis (1959) recognized the loss of oak savanna ecosystems, stating that "an oak savanna with an intact ground layer is the rarest plant community in Wisconsin today." According to the Wisconsin DNR (2017b), the NatureServe Global Conservation Status global rank for oak opening is G1: Critically Impaired. The state ranking, S1, also indicates the status at the state level. Oak savannas remain one of the most endangered ecosystem types on earth.

The genus *Quercus* is represented by approximately 464 species worldwide, of which 91 species occur in North America, making it the largest tree genus in the northern hemisphere (Global Tree Campaign 2020). Tallamy (2021) asserts

TABLE 3. Summary of the number of line and bearing trees for *Quercus* species recorded for oak woodlands and oak openings in the four survey townships surrounding Green Lake (Wisconsin Board of Commissioners of Public Lands 2023).

Township	Common Name	Scientific Name	No. of Trees	% of Total
T15N R12E SW LAKE	Black oak	*Q. velutina*	41	24.3
	White oak	*Q. alba*	41	24.3
	Bur oak	*Q. macrocarpa*	87	51.5
Total			169	100
T15N R13E SE LAKE	Black oak	*Q. velutina*	26	22.8
	White oak	*Q. alba*	50	43.9
	Bur oak	*Q. macrocarpa*	38	33.3
Total			114	100
T16N R12E NW LAKE	Black oak	*Q. velutina*	80	33.6
	White oak	*Q. alba*	79	33.2
	Bur oak	*Q. macrocarpa*	79	33.2
Total			238	100
T16N R13E NE LAKE	Black oak	*Q. velutina*	46	22.4
	White oak	*Q. alba*	82	40.0
	Bur oak	*Q. macrocarpa*	77	37.6
Total			205	100

that oaks are vital keystone community members in the local food web, providing habitat and food for a diversity of animals, particularly insects. Apart from pests and diseases, land use development, non-regenerative agricultural practices, and the longevity and slow growth of oaks may make them more vulnerable to climate change (Global Tree Campaign 2020).

TABLE 4. Number of corner and quarter section samples, mean links from post to tree, and trees per acre for each of the four survey townships surrounding Green Lake (Wisconsin Board of Commissioners of Public Lands 2023).

Survey Township	Corner Section Samples	Quarter Section Samples	Mean Links Post to Tree	Trees/Acre
T15N R12E SW LAKE	52	89	189	1
T15N R13E SE LAKE	37	61	159	2
T16N R12E NW LAKE	71	59	102	5
T16N R13E NE LAKE	49	107	102	5

Historical Narratives

The historical record of the vegetation cover surrounding Green Lake based on the original survey field notes is further supported by studies of Native American influences on the vegetation and eyewitness accounts by early pioneers and settlers through published and unpublished narratives.

Native Americans were the earliest humans to influence the vegetation in ways mostly related to obtaining food (Curtis 1959). Strong circumstantial evidence suggests that use of fire by the Ho-Chunk Nation, the primary inhabitants of the region, indirectly and directly influenced the vegetation cover (Dorney 1981; Dorney and Dorney 1989). Controlled fires were used to drive wild game, clear land for gardens and to create buffers that protected campsites from wildfires in the spring and fall. Fire disturbance, caused naturally or by human activities maintained a dynamic mosaic of oak openings and open woodlands, prairie, and wetlands. These plant communities are fire-dependent and required periodic conflagrations for their perpetuation.

In June 1840, pioneer Anson Dart and his three sons, Putnam, Charles, and Richard, become the first permanent Euro-American settlers to row across Green Lake and stake their land claim one-half mile south of Sandstone Bluff near Twin Lakes, Green Lake Township, Sections 32 and 33, T16N, R13E (43.81751, -88.96514) (Heiple and Heiple 1976).

The landscape that included the original 80 acres acquired by Anson Dart in the NE ¼ section 5, T15N R13E was reconstituted from memory by Richard Dart (1910) when he explained: "There were no settlers there as yet, only wigwams of the Winnebago [Ho-chunk] grouped or scattered around the lake. There was no timber then, but oak and clay openings, with Green Lake prairie to the south."

From 1843 and on, accelerated settlement resulted in significant changes in the vegetation. Even though commercial logging did not occur on any appreciable scale, oak woodlands played a vital role in the development of farming by furnishing fuel and the materials for building homes, barns, fences, and bridges. Richard Dart (1910) explained how the local timber resources were utilized when his family arrived in 1840:

> *We soon crossed the lake and reached our land* [Section 5 T15N R13E], *of which my father recognized the quarter-section corner. We lugged our stuff up by hand from the lake* [near Sandstone Bluff], *erected a shanty for shelter, and at once went to work to build a plank house. We split and hewed white oak* [Quercus alba] *planks, about two inches thick by six feet long, and set them upright, two lengths end-to-end twelve feet high, held together by grooved girts or stringers. We used poles for rafters and "shakes" for shingles, the latter shaved out of green oak.*

Following settlement, the suppression of fire on landscapes resulted in significant changes in the vegetation cover. In a study of the factors that contributed to changes in vegetation patterns in presettlement southern Wisconsin, Leitner et al. (1991) reported that "alteration of the fire regime was most evident in the ecotones between prairie and forest, where savanna remnants were soon converted into closed *Quercus* [oak] forest."

Anecdotal observations detailed by Gillespy (1860) of the county's oak openings during early Euro-American settlement describe changes in vegetation cover that coincides with fire suppression and early farming:

> *The general face of the country, is undulating; neither hilly or extensive plains, (with the exception of high, broken lands around the marshes, in the south part of the county,) handsome rolling lands. The openings, in the first settlement of the county, were kept free from underbrush, by annual fires, which now are not frequent. Lands, which but a few years ago, presented the appearance of a well kept lawn, are now filling up with a thick underbrush. These openings are some of the finest lands in the State. Although the prairies are considered the most productive, yet by many of the settlers, the openings are considered more reliable, one year with another, for a crop; and in consideration of wood, water, with many other advantages they afford over the prairie, often selected in preference.*

In Brooklyn Township, which includes portions of northern and eastern Green Lake shores, Gillespy (1860) reiterates a description of a dense undergrowth caused by the cessation of annual fires:

> *Lands covered, generally, with a thrifty growth of oaks, and as in most all other localities, a dense growth of underbrush, since the annual fires have ceased destroying young and tender plants sprouting from year to year.*

In the present-day City of Green Lake between sections 21 and 28, T15N R13E, near the west end of Illinois Avenue and the former Oakwood Resort (43.8370, -88.9587), the field notes recorded "Land rolling second rate Thinly timbered with W B & Bur oaks". Numerous field note entries record survey line summaries with the similar verbiage, e.g., at the corner sections 16, 17, 20 and 21, T15N R13E, one quarter mile east of the junction of State Highway 23 and North Street, near the Dartford Cemetery (43.8525 -88.9654): "Land rolling second rate Thinly timbered with W B and Bur oaks".

The eyewitness account by Richard Dart (1910) noted the lack of forested lands around most of Green Lake in the mid-nineteenth century:

> *There was at this time no heavy timber around the lake, except at the foot* [Silver Creek inlet], *in the marshes□only what were called "clay openings," burned over each autumn by the prairie fires.*

The "clay openings" are a reference to exposed clay loam on till plains and moraines where the soil layer is erodible and thin, ranging from depths of 0–5 feet and 5–50 feet above the dolomitic bedrock (Schmidt 1987).

Tallgrass prairie covered the level and rolling uplands in southeastern part of Green Lake County. Remnants of this prairie would later be named for the civils townships where they occur, Green Lake and Mackford prairies. Dart (1910) stated:

> *All the while, we were clearing and breaking land. It was thin and poor in the clay openings, and as yet we did not know how to farm to advantage. Father used to repair grist-mills and sawmills as far off as Watertown, leaving us boys to run the farm. Finally we got enough money together to go up on the prairie and buy a "forty" of better land, with richer soil.*

Prairie and oak openings that bounded wetlands were frequently mentioned by early settlers and visitors in letters and journals. Julia Peck Sherwood, in a letter to her sister Harriet Sage and family dated August 28, 1854, described a trip from Dartford (renamed Green Lake in 1907) to Ripon.

> *Last Friday I went with Mr. S* [William C. Sherwood] *to Ripon, a village about seven miles from Dartford that was the farthest I have rode since I arrived here and the first time that I have past over any green prairie* [State Highway 23 between Green Lake and Ripon]. *It was a beautifully grand prospect to see one uninterrupted, unbroken undulating meadow as far as the eye could extend towards the Missippie* [sic] *with occasionally a herd of cattle of thirty or forty, they always keep in companys* [sic]. *The land was cultivated along where the road passed, or some of it was, but it looks strange to see so few fences where the country looks as if it had been cleared. Mr. S has no prairie, he has one large marsh that serves him for a meadow* [wetlands bordering Green Lake Mill Pond], *but all the cattle in the vicinity feed on it if they choose, but there is good pasturage in the woods here, the trees are so small and scattering. They are all oaks, and there are places that they call oak openings of many acres that there are no trees or stumps* (Sherwood 1854).

From her description, it is plausible that Julia Peck Sherwood had observed oak grubs, small oaks with multiple stems that arise from oak seedlings whose tops are killed by fire. Oaks are uniquely adapted to fire and the grubs may remain alive for many years without growing into saplings. Johnson et al. (2019) reported that oak grubs may develop extensive root systems that are many years older than their living stems and can produce saplings when environmental conditions change that allows for sprout growth.

Trees, notably oaks, were harvested for lumber and fuel while savanna was converted to cropland. It was common practice to "green up the woods" for pasture by burning. These routine fires were started and left unattended to burn where they would. In some instances, controlled burns were practiced for safety precautions, as described by Dart (1910): "Every fall we had to burn round everything□house, sheds, and stacks□to save them from these fires that annually swept the prairies."

Gillespy (1860) noted the lands utilized for pastures and farming:

> *The sandy lands of Brooklyn, St. Marie, Princeton, Marquette, Kingston, Seneca and part of the town of Berlin, with their never ending supply of hay and pasturage, are a paradise for cattle, and when the prairies and burr* [bur] *oak openings, by continual cropping and plowing, becomes exhausted, these lands will be sought for, with avidity, and realize what God has decreed, that the marshes are to be a never ending source of wealth to the owner.*

The presence of prairies and savannas are frequently inferred or explicitly stated in the early land surveys throughout the survey townships in the Green Lake region. From the field notes of December 1834 for the area two miles southwest of Center House (43.7916, –88.9557), at the corner post of sections 16, 17, 20, and 21, T15N R13E, the record states "Land rolling second rate Mostly prairie." Further south, in what would later be referred to as part of Mackford prairie, between sections 27 and 34, T15N R13E, the land is described as ". . . level 1st rate Prairie." Where line and bearing trees were absent, an earthen mound was prepared: "Set post & erected on mound of earth and rocks."

Further evidence of a prairie and savanna-dominated landscape is apparent

from Richard Dart's memory of the Green Lake prairie flora described decades later:

> *I wish I could adequately describe the prairie flowers. Every month during spring and summer they grew in endless variety—such fields of changing beauty, I never saw before. It was a flower-garden everywhere. You could gather a bouquet any time, that couldn't be equalled* [sic] *in any greenhouse of New York or Chicago. There were double lady-slippers, shooting-stars, field-lilies, etc., etc. Some of them still linger beside the railway tracks. We tried over and over to transplant them, but only the shooting-stars would stand the change. There was also the tea-plant, whose leaves we dried for tea. When in blossom, the oak and clay openings, for miles around, were white with it, like buckwheat. We also had splendid wild honey from the bee-trees* (Dart 1910).

Forested habitats were afforded some protection from fire where they occurred in wet floodplains and stream valleys. Prior to the damming of the Puchynan River, Green Lake's outlet, lake levels were considerably lower. The lake's main tributary, Silver Creek, was not the wide inundated estuary with floating and submergent vegetation that it is today, but rather a diminutive meander that flowed through marsh, sedge meadow, lowland forest, and swamp. Among trees present in the timbered floodplain as recorded in the field notes were black ash (*Fraxinus nigra*), white ash (probably green ash, *F. pennsylvanica*), elm and white elm (*Ulmus rubra* and *U. americana*), cherry (probably *Prunus serotina*), sugar maple (*Acer saccharum*), aspen (*Populus tremuloides*), various willows (*Salix* spp.), and red-osier dogwood (*Cornus sericea*).

In 1844 Anson Dart, his son Richard, and Smith Fowler constructed the original Mill Pond dam to power a lumber mill, then later a gristmill (Heiple and Heiple 1976). The dam significantly modified Green Lake's littoral zone and adjacent wetlands by raising the lake level and flooding Silver Creek east off County Road A and opposite of Sunset County Park, SW ¼ Section 26, T16N R13E (43.8277, –88.9274).

Another early resident in the area, S. D. Mitchell, reported lowland forest occupying the east end of Green Lake when Silver Creek was a diminutive flowage.

> *It might be well to state here that the intire* [sic] *shoar* [sic] *line of the lake was changed by the building of a dam across the out let* [outlet] *called the Puchyann* [Puchyan] *River at Dartford in the year 1844. This dam Raised the level of the lake some Four feet or more flooding a large tract of very heavy timber... some years since parties removed the over flowed stumps in the shallow watter* [sic] *between this* [Silver Creek inlet, SW ¼ section 26; 43.82511, -88.92336] *and the Lake.* (State Historical Society of Wisconsin 1888).

Mitchell's reference to sugar maple emphasized the dependence of Native Americans and early settlers on a nearby tract of maple-basswood forest in and around Mitchell Glen (43.8159, –88.9154), a present-day conservancy property. Approximately one mile northwest of Mitchell Glen, another conservancy land, Sugar Island (43.8274, –88.9238), served as a peninsular campsite along Silver Creek by the Ho-Chunk. Mitchell wrote:

> [A] *small island* [SW ¼ section 26 T16N R13E] *known as sugar creek island this is surrounded on the north and west by silver creek and on the south and east by swamps this is-*

land formerly was covered with heavy maple timber here again was shown the hacking gouging present of the Indians mode of taping [sic] *the maple with his rude implements...* (State Historical Society of Wisconsin 1888).

In the survey field notes for the area north between sections 26 and 27, T16N R13E, along what is today referred to as "Inlet Road" (County Road A), "Lynn [basswood] with a 16" diameter is reported. In the same notes is the following passage: "Land first part swamp Last part except marsh rolling second rate thinly timbered with W B & Bur oak." For the area that is less than a mile northeast, where South Street passes the Sunnyside entrance, the field notes state "Random between Sections 23 & 26", a "Stream" (Silver Creek) is crossed, then "Enter heavy timbered land."

Land First part rolling 2nd rate
Scattering W. B & Bur oak
Last part timbered with W. B & Bur oak
Maple Sugar with thick undergrowth of Briars [Rubus sp.] *Hasle* [Corylus americana]
West corrected between Sections 23 & 26
Set quarter section post B Ash W Ash

The vegetation cover for most of the immediate area surrounding Mitchell Glen was oak savanna. Upland tallgrass prairie, which transitioned to oak opening, flanked the southern margin, while extensive oak openings occupied the areas southwest and northeast of Mitchell Glen. Historically, recurrent fires greatly influenced the vegetation cover by diminishing woody succession and favoring oak savanna. Although most of the prairies and oak openings were placed into cultivation during the latter half of the 1800s, the dominant vegetation cover for Mitchell Glen remains maple basswood forest (Eddy 1999).

In contrast, based on the field notes for areas near the shores around Green Lake, forested tracts of land were evidently sparse and widely scattered. For example, north between sections 33 and 34 T16N R13E:

36.00 Set post on Green Lake
W. oak 24 S66W 1.48
Bur oak 6 N71E .46
Land rolling thinly timbered with W B & Bur oak

Immediately west of Sandstone Bluff, north between sections 33 and 34 T15N R13E, "Land rolling second rate scattering W B & Bur oak." Continuing west near present-day Emerald Shores, between sections 6 and 7 , white oak and red cedar are recorded, while the area included as part of Tuleta Hill, between sections 6 and 7 T15N R12E, "Land rolling second rate Blk W & Bur Oak."

Further west, at Tichora Conservancy, between sections 11 and 12, T15N R12E the entry reads: "Fell into line North side of [Spring] Lake Hickory 12." Then approaching the Green Lake shore: "Larger Lake. A Red Cedar 12 on South Bank." Continuing west, between sections 14 and 15, T15N R12E, where another conservancy property, Blackbird Point (43.7839, –89.0402) is located: "Set quarter section post in Marsh no trees" and at section corners 10, 11, 14 and 15 bur oaks with 18- and 20-inches diameter were recorded.

At the west end of the lake, what is locally referred to as Green Lake Terrace

(43.7798, –89.0621), off Lake Shore Drive, north between sections 9 and 10, T15N R12E: "Land hilly third rate scrubby Blk W & Bur Oak." The description is suggestive of well-drained sandy soils and recurring fires on the landscape.

Following the lakeshore to Sugarloaf (43.8070, –89.0348), a dolomitic-capped peninsula between sections 1 and 2, T15N R12E the land is "rolling second rate Oak Lynn [basswood] Iron wood [ironwood] Cedars [red cedar]."

Having gone full circle around the lake and ending on the eastern side of the Green Lake Conference Center (43.8372, –89.0088), west between sections 19 and 30, T16N R12E, again oak savanna is recorded: "Land rolling poor Second rate Scattering B W & Bur Oak."

CONCLUSIONS

It has been 184 years since Anson Dart and his sons arrived at Green Lake (Heiple and Heiple 1976). The evidence gathered from the survey field notes, historical narratives and eyewitness accounts record a pre-Euro-American vegetation cover dominated by oak savanna that surrounded most of Green Lake. The presettlement landscape and vegetation cover witnessed by Anson Dart and other early settlers who sustained a livelihood by farming the prairies and oak openings provided a sense of place for these land-hungry pioneers.

Shaped by climate and fire, influenced by Native Americans and then later by early settlers, the landscape today contains only fragmented remnants of original oak savanna. Fire suppression and ecological succession abetted an increase in the acreage and distribution of woodlands, from farm woodlots and hedgerows to dry timbered escarpments and tracts of lowland forest and swamp.

According to WisconsinForestry.org (2023):

> *After heavy logging early in the 20th century, much land was burned and converted to agriculture. But, since the 1930's, much marginal crop and pastureland has been planted with trees so the state now has more forestland than at any time since inventories began in 1936.*

Decades of tree plantings have occurred since settlement. Red and white pine plantations were established to stabilize soils, some later harvested for lumber and pulpwood. Public and private lands have been planted and managed for wildlife habitat. Landscape plantings by municipalities and private individuals include Wisconsin native trees, but not native to Green Lake County, such as river birch (*Betula nigra*), white cedar (*Thuja occidentalis*), white spruce (*Picea glauca*), sycamore (*Platanus occidentalis*) and American beech (*Fagus grandifolia*), to name a few.

In addition, numerous exotic cultivars have been introduced: Norway spruce (*Picea abies*), blue spruce (*Picea pungens*), northern catalpa (*Catalpa speciosa*), ginkgo (*Ginkgo biloba*) and weeping willow (*Salix babylonica*). Other nonnative species such as black locust (*Robinia pseudoacacia*), Norway maple (*Acer platanoides*), European buckthorn (*Rhamnus cathartica*) and glossy buckthorn (*Frangula alnus*) are introductions that are naturalized and ecologically invasive.

While not native to Wisconsin, American chestnut (*Castanea dentata*), a species devastated by the exotic chestnut blight, was introduced and established in the Green Lake Conference Center and at certain private residences as well.

The mature trees viewed today are less than 125 years old (WisconsinForestry 2023). The forested shores of present-day Green Lake are not entirely original—they are a result of natural dispersal and deliberate and accidental introductions accompanied by fire suppression and woody succession.

Upon reconsideration of George L. Richards' lithograph "Birds Eye View of Green Lake Wis. 1875," one landscape depiction is truer now than in 1875. Today there are indeed sylvan shores encompassing a majority of Green Lake shores, and they will likely continue to grace Wisconsin's deepest inland natural lake for many years to come.

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IN MEMORIAM—JAMES S. PRINGLE

A. A. Reznicek
University of Michigan Herbarium
Ann Arbor, MI 48108
reznicek@umich.edu

The Great Lakes region has lost one of its most eminent botanists with the passing of Dr. James Scott Pringle, Jim to all Great Lakes botanists, on September 3, 2024, in Hamilton, Ontario.

Jim was born in Danvers, Massachusetts, on August 14, 1937, and grew up in Laconia, New Hampshire, where he attended public school and graduated high school in 1954. Jim developed an acquaintance with the local flora through all the natural areas close to town. His interest in cultivated flora was attributable to his mother and a next-door neighbor, whose gardens were developed "more as plant collections than as landscaping" (Pringle 1995). Jim received his Bachelor's degree in 1958 from Dartmouth College in Hanover, New Hampshire, and a Master's degree in 1960 from the University of New Hampshire at Durham. Jim first developed his interest in lilacs (*Syringa*) working at the University of New Hampshire with the renowned lilac expert, Dr. Owen M. Rogers. Jim moved south for his doctorate, working on the systematics of gentians (*Gentiana*) with Dr. Aaron J. "Jack" Sharp at the University of Tennessee in Knoxville. Jim went directly from his graduate work to join the Royal Botanical Gardens in Hamilton, Ontario in 1963, where he spent his entire career (Figure 1).

As a plant taxonomist at the Royal Botanical Gardens, Jim was able to work both with cultivated plants, especially lilacs and *Clematis*, and also with the wild flora, including expanding his work on the Gentianaceae, working with the flora of the Great Lakes, and developing an interest in naturalized plants of the Ontario flora. In addition to his work on plants, Jim developed an interest in botanical history, especially the plant exploration of Canada and the Great Lakes region. In this latter interest, he was influenced by Dr. Joseph Ewan, then of Tulane University, Dr. Ronald L. Stuckey of Ohio State University, and Dr. Edward G. Voss of the University of Michigan.

Jim enjoyed studying plants in the field. Having developed an appreciation of the southern Appalachian flora while at Knoxville for graduate work, he participated for many springs in the Great Smoky Mountains wildflower pilgrimage (of which his major professor, Dr. Sharp, was one of the founders) until prevented by COVID. Dr. Sharp taught bryology during the summer at the University of Michigan Biological Station (U.M.B.S.), and encouraged Jim to attend. There, as a graduate student in 1961, a teaching assistant in 1962, and an investigator in 1963, Jim developed a lifelong interest in Great Lakes endemics and other special plants of the Great Lakes shorelines, noting: "Of all my time at universities, I most enjoyed my summers at U.M.B.S." (Pringle 1995). He was especially in-

FIGURE 1. Jim Pringle at the Royal Botanical Gardens in the 1960s. Photo courtesy of the Royal Botanical Gardens Archive.

terested in chromosome numbers of Great Lakes shoreline plants, goldenrods, and introduced species. Largely during his stays at the Biological Station, Jim collected nearly 200 herbarium specimens in Michigan, most of them housed at the University of Michigan Herbarium, He was also responsible for the herbarium at the Royal Botanical Gardens, an important repository of specimens of the Ontario flora, the gentian family, and cultivated plants (Figure 2).

Jim's botanical publications have been numerous and diverse. He has contributed treatments of the gentian family to many flora projects, including *Flora of North America*, *The Jepson Manual: Vascular Plants of California*, and various regional and neotropical floras. His publications ranged from floras to nomenclature to taxonomic treatments of selected plant groups, both cultivated and wild, to botanical history. He contributed 15 papers to The Michigan Botanist and The Great Lakes Botanist from 1965 to 2022 (Appendix 1). Among his scholarly and detailed papers on botanical history, one especially noteworthy contribution should be better known, his *Botanical Exploration of the Canadian Watershed of Lake Huron During the Nineteenth Century* (Pringle 1989), as it

FIGURE 2. Jim Pringle in the Herbarium at the Royal Botanical Gardens examining a gentian specimen, 2016. Photo by Mark Zelinski.

forms a companion treatise to Ed Voss's *Botanical Beachcombers and Explorers* (Voss 1978).

Over his career, Jim described about 50 new species of plant, mostly in the gentian family, and made large numbers of new combinations as he modernized classifications, especially in the gentian family. He also described, with Pamela Laureto, the Michigan endemic goldenrod *Solidago vossii* J. S. Pringle & Laureto (Laureto and Pringle 2010).

In parallel with his enjoyment of plants in the wild, Jim enjoyed sharing his knowledge of plants. He was an adjunct Associate Professor of Biology at McMaster University in Hamilton starting in 1974 and taught various botany courses there for many years, and he also taught summer classes at the Queen's University Biological Station on Opinicon Lake near Chaffey's Lock, Ontario. This was in addition to numerous courses and field trips for the public at the Royal Botanical Gardens. He was also a stalwart field trip leader for the Field Botanists of Ontario, and he had other natural history interests as well, including birding.

For his contributions to Ontario botany, the Field Botanists of Ontario presented Jim with the John Goldie Award in 2011. In 2023, the Canadian Botanical Association granted him its most prestigious award, the Lawson Medal, for his cumulative contributions to Canadian botany. In addition, the Royal Botanical Gardens dedicated the James Pringle Gentian Garden in 2013 for his 50th anniversary on staff.

Three recently described members of the gentian family honor Jim's contributions to plant systematics: *Gentiana pringlei* M. Shabir, P. Agnihotri, J. K. Ti-

wari & T. Husain; *Kuepferia pringlei* D. Maity & S. K. Dey; and *Macrocarpaea pringleana* J. R. Grant.

Thanks to Dr. David A. Galbraith, Director of Science at the Royal Botanical Gardens, Hamilton, for his help with this memorial and for supplying photos. Karie Slavik kindly provided information about Jim's summers at the University of Michigan Biological Station.

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NOTEWORTHY COLLECTIONS

LESPEDEZA VIOLACEA (L.) PERS. (FABACEAE), A NEW SPECIES FOR WISCONSIN, U.S.A.

Theodore S. Cochrane
Wisconsin State Herbarium, Department of Botany
University of Wisconsin-Madison
430 Lincoln Drive
Madison, WI 53706
tscochra@wisc.edu

Significance of the Report. No previous specimen of this species from Wisconsin was found.

Previous Knowledge. *Lespedeza violacea* (L.) Pers. (Fabaceae) (violet lespedeza), long known under the synonym *L. intermedia* (S. Watson) Britton, is a perennial herb native to eastern North America, ranging from Florida to Louisiana, north to southwestern Maine, Vermont, and southern Ontario, west to Michigan, northwestern Indiana, eastern Oklahoma, and Missouri (reports for Kansas were disallowed by McGregor 1986). Fernald (1950) stated that the range of this species includes Wisconsin, but no specimen of this species from Wisconsin was found when searching collections on Harvard University Herbaria databases (HUH-Databases 2023). Gleason and Cronquist (1991) seemingly excluded Wisconsin when giving the western limit of the range as "Mich. and Okla....to Tex." Neither was it attributed to Wisconsin by Fassett (1939), Clewell (1966), Isely (1955, 1998), or Wetter et al. (2001), but Clewell did report disjunctions as far west as southeastern Minnesota, northwestern Illinois, and northeastern-central Texas. Searches under the Online Virtual Flora of Wisconsin (Wisconsin State Herbarium 2023) and Consortium of Midwest Herbaria (2024) failed to locate any specimens from Wisconsin.

Lespedeza violacea is also attributed to Wisconsin by Ohashi (2023). Thus, the specimens cited below would seem merely to represent no more than the second record for the state; however, his account likely misrepresents the real situation. In correspondence Dr. Ohashi (pers. comm.) writes that specimens of *Lespedeza* examined by him are mostly in HUH and TUS and that when preparing the manuscript on the genus for FNA, he referred mainly to works by Clewell (1966) and Isely (1990), as well as Fernald (1950). He goes on to say that "actually, the data on range statements in my parts [seven generic treatments] were probably supplied by the editors [and reviewers] of FNA." A subsequent search at TUS has failed to find any specimen from Wisconsin named either *L. violacea* or its synonym *L. intermedia*. In the absence of a verifiable specimen, I am con-

fident that the inclusion of Wisconsin in the FNA volume is based on the range given in *Gray's Manual*.

The state and county data mapped on POWO (2024), GBIF (2023), the PLANTS Database (USDA NRCS 2023), and the North American Plant Atlas (Kartesz 2015) for Michigan, Wisconsin, Iowa, Kansas, Oklahoma, and doubtless other states clearly pertains to a different species, the one formerly called *Lespedeza violacea* and to which the name *L. frutescens* (L.) Hornem. is now applied (see Reveal and Barrie 1991 for clarification of the nomenclature). It is discouraging to contemplate the amount of confusion, published and unpublished (e.g., citizen science projects), that exists, depending on the nomenclature being followed.

Discussion. This small but expanding population was discovered by Sue Steinmann while compulsively pulling spotted knapweed in the summer of 2017. She recognized it as being a bush-clover (a common name for many species of *Lespedeza*) and decided to wait for it to flower before sending a specimen to the Wisconsin DNR for determination. The following year, I was shown the plants on the occasion of a tour of the nearby black oak barrens, decided it might be a species new to the flora, and took a sterile specimen that I soon determined to be *Lespedeza violacea*. Told on September 10 that the plants were starting to bloom, I returned the next day to contend with the Japanese beetles over the least damaged flowers.

Historically, the land was part of a farm, all of which was grazed by cattle through the 1970s, including the wooded hillsides, and corn cribs stood about 30 meters away from the spot occupied by the bush-clover at the time the land was subdivided in 1984 (Steinmann, pers. comm.). The site is the narrow, lower end of a recovering old field, hemmed in on three sides by a private easement road and a strip of young woodland and separated in part from the latter community by a low, artificial berm that must have been pushed or piled up when the nearest house or the road was built. The soil is light-colored, loose, fine sand with a definite but extremely thin zone of organic matter in the surface, a zone entirely missing barely upslope (some 7 m) where the same sand is uniform throughout its occurrence, implying that there, subsoil has been exposed and/or, like the aforementioned oak barrens, the immediate area is developed on old dune sand rather than sandy loam.

The lespedeza stems were solitary or up to 75 together in loose clumps and mostly 0.3–0.6 m tall; only the tallest ones were producing inflorescences. The clumps tended to grow into one another, forming five small patches that collectively occupied an area of about 26 m^2 spread over a shallowly deltate-shaped area 8.4 × 9.1 m.

The habitat is dominated by grasses characteristic of sand barrens and dry prairies, especially *Poa compressa* L. and *Schizachyrium scoparium* (Michx.) Nash, along with *Aristida tuberculosa* Nutt., *Dichanthelium oligosanthes* (Schult.) Gould, *Digitaria cognata* (Schult.) Pilg., *Elymus repens* (L.) Gould, *Paspalum setaceum* Michx., and *Sporobolus cryptandrus* (Torr.) A. Gray. The prominent co-occurring herbs are *Ambrosia psilostachya* DC., *Berteroa incana* (L.) DC., *Conyza canadensis* (L.) Cronquist, *Monarda punctata* L. subsp. *villicaulis* Pennell, *Lespedeza capitata* Michx., *Mirabilis nyctaginea* (Michx.)

MacMill., and *Verbena stricta* Vent. The only woody associate is low-growing *Rhus glabra* L.

I suspect that *Lespedeza violacea* is not native to the site but originated as an accidental introduction. The Wisconsin Land Economic Inventory's land cover map (1935), the Wisconsin Historic Aerial Image of 1937 (USDA 2023), and the U.S. Geological Survey's Arena Quadrangle (7.5-minute series, 1962) all show the site lying within cleared crop land extending to the very base of the bluffs. We have no good idea how long the population may have been present or whether plants might have arrived from elsewhere in the area, but they occupy ground that was disturbed all the years the land was farmed and probably again when easement driveways were installed or paved or the nearest house built. Furthermore, because the plant is actively spreading, this population would be expected to be larger had it been present much earlier than when it was discovered.

Diagnostic Characters. The foliage of *Lespedeza violacea* appears rather like that of *L. frutescens*, but the stems are stiffly erect to ascending, usually wand-like, and branch only above the middle, whereas in *L. frutescens* they are slender, strongly spreading or forking, then commonly become sprawling, and they branch much of their length. The chasmogamous inflorescences of *L. violacea* are compactly flowered, crowded among the upper leaves, and about as long as or only slightly protruding beyond the leaves, but in *L. frutescens*, the inflorescences are open, not clustered among the upper leaves, and on very slender peduncles generally well exserted beyond the subtending leaves. When growing in the open, *L. violacea* tends to have congested, small leaves, but in shade it presents a different appearance, being more sparsely foliose and having larger leaves. Such plants may be confused with depauperate or non-flowering *L. frutescens*. Other important differences are in the corollas (keel shorter than the wings in *L. violacea*, longer than the wings in *L. frutescens*) and calyces of cleistogamous fruits (ca. 1/4–1/3 as long as the pod in *L. violacea*, up to 1/5 [rarely 1/4] as long as the pod in *L. frutescens*).

Specimen Citations. Wisconsin. Iowa County. E side of easement driveway opposite 7060 Reimann Rd., 17–20 yds S of the point where that driveway diverges from the one going up to 7046 Reimann Rd., 0.5 mi. due S of U.S. Hwy. 14 in the Village of Arena (N43.154256, W89.907356; elev. 236 m). Ca. 20 loose clumps of erect, crowded stems growing into one another to form an irregularly shaped, triangular stand 3.7 × 4.6 m. August 4, 2018, *T. S. Cochrane, B. A. Cochrane, S. A. Steinmann, & J. Ketelle 16025* (WIS); ibid., stems single or in clumps of 4, 10, 13, 30, etc., up to 75 . . . forming 5 small patches spread over an area deltate in outline, 8.4 × 9.1 m . . . September 11, 2018, *T. S. Cochrane 16035* (GH, MIL, NY, WIS-2 sheets).

ACKNOWLEDGMENTS

I would like to thank Sue Steinmann for calling people's attention to this population of bush-clover; Ellie Taylor, Curatorial Assistant, Harvard University Herbaria, for confirming that all of their *Lespedeza violacea* specimens are digitized and that none of them is from Wisconsin; and Hiroyoshi Ohashi, Professor Emeritus, Tohoku University, Sendai, Japan, for searching collections at

TUS for Wisconsin specimens of *L. violacea*. I am particularly grateful to Dr. Ohashi for his prompt and gracious attention to my various questions.

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NOTEWORTHY COLLECTIONS

THE REDISCOVERY OF *ELEOCHARIS GENICULATA* (L.) ROEM. & SCHULT. (CYPERACEAE) IN ILLINOIS WITH TAXONOMIC NOTES

Nathanael J. Pilla
Midwest Biological Survey, LLC.
225 Michigan St.
Porter, Indiana 46304
npilla@midwestbiologicalsurvey.com

Alison Anastasio
University of Chicago
924 E. 57th St.
Chicago, Illinois 60637
aea@uchicago.edu

Significance of the Report. The first collections of *Eleocharis geniculata* in the state of Illinois since 1894.

Previous Knowledge. *Eleocharis geniculata* (L.) Roem. & Schult., commonly called Capitate Spike-rush (Figure 1), is a small, cespitose annual sedge that grows in brackish wetlands, calcareous swales and lakeshores, and marly fens in the Great Lakes region of the United States and Canada (Menapace 2003; MICHIGAN FLORA ONLINE 2011; Wilhelm and Rericha 2017). Its distribution in the Great Lakes region which is limited to a few counties near the northern edges of the states Pennsylvania, Ohio, Indiana, and Illinois and in southern Ontario, is disjunct from its general pantropical and warm-temperate distribution, including a widespread distribution in the southern United States (Menapace 2003; Lunkai and Strong 2010; Kartesz 2015). The plants occurring in the Great Lakes region have darker scales that are purplish, whereas the more tropical and warm-temperate individuals have straw-colored scales (Hill 1881; MICHIGAN FLORA ONLINE 2011). This has led some taxonomists to separate these individuals as a distinct, endemic Great Lakes species described as *Eleocharis dispar* E.J. Hill, or as a variety *Eleocharis geniculata* (L.) Roem. & Schult, var. *dispar* (E.J. Hill) Blake (Hill 1881; Hermann 1935). One suggested common name of the Great Lakes taxon is Inland Capitate Spike-rush. The name *Eleocharis caribaea* (Rottb.) Blake has been applied to this species (e.g., Gleason and Cronquist 1991; Voss 1972); however, Wilson (1990) showed that the earlier name, *Scirpus geniculatus* L., applies to the same species and therefore the specific epithet geniculata has priority.

The taxonomy of the *Eleocharis geniculata* complex remains complicated. The recent resurrection of *Eleocharis microformis* (O'Kennon and Taylor 2013)

FIGURE 1: *Eleocharis geniculata* at State Line Slag Prairie. August 9, 2023. Photo by Nathanael J. Pilla.

as a species distinct from *E. geniculata* challenges the taxonomic boundaries within the complex, while the status of the Great Lakes populations identified by E.J. Hill as a distinct species is still uncertain (A. A. Reznicek pers. comm.). Further research employing multi-disciplinary analyses will be crucial in resolving these taxonomic dilemmas. Unraveling the complexities of the *E. geniculata* complex will not only advance our understanding of plant diversity, but will also hold potential implications for conservation and ecological management. By clarifying the identities and relationships within this challenging group, we can better understand their distribution, habitat preferences, and potential threats.

Due to its late phenology in the Great Lakes region (July–September), successful establishment and persistence of the species is contingent upon the availability of open habitats with low competition from other plant species (Environment Canada 2016). It is considered a species of conservation concern in Indiana, Michigan, Ohio, Ontario, and Pennsylvania (NatureServe 2023).

Prior to this report, *Eleocharis geniculata* was presumed extirpated in Illinois (P. Marcum pers. comm.). There has been one historical collection in Illinois, which was in Cook County from the south side of Chicago on the border of Wolf Lake in 1894 (Hill s.n., F, accession number 462680). Occurrences of the species are documented frequently in northwestern Indiana, as evidenced by data on the Consortium of Midwest Herbaria (2024) portal.

Discussion. *Eleocharis geniculata* was discovered at three sites during floristic surveys of Calumet Slag Barrens in southeastern Cook County, Illinois in 2023. All three populations were growing in wet, calcareous habitats where slag was historically deposited in northeastern Illinois. Populations of *E. geniculata* were observed and collected in 2023 from three sites in a local novel ecosystem colloquially referred to as Calumet Slag Barrens in Cook County, Illinois. These were the Marian R. Byrnes Park (Marian Byrnes) on July 31, the Big Marsh Park (Big Marsh) on August 26, and 3300 & State Line Slag Prairie (State Line) on August 26. These sites, are in what Merwin et al. (2022) called the Chicagoland Slag Ecosystem, which is the spontaneous vegetation that has assembled and persisted on slag, which in turn is waste matter laden with heavy metal as a by-product of steel production. Calumet Slag Barrens harbors a diverse community of plant species consisting of a mix of common ruderal species of disturbed open ground and native calciphiles. Species of higher conservation value are at a greater density in areas of the slag ecosystem that harbor ephemeral wetlands (personal observation). Soils tend to be calcareous and with locally high concentrations of heavy metals such as chromium and lead (Kay et al. 1997; Piatak et al. 2019).

At Marian Byrnes, *Eleocharis geniculata* was scattered throughout the northwestern edge of a wetland stretching approximately 150 meters in water a little over three centimeters deep. This water depth was influenced by recent heavy rainfalls in a season of overall low average rainfall and a severe to moderate drought during the month of June and July (NIDIS 2024). At the time of the collection, only a few individuals had mature achenes necessary for proper identification. Several species of *Chara* dominated the adjacent submergent community.

No populations of *Eleocharis geniculata* were initially observed during the vegetation survey on August 1, 2023, at Big Marsh. However, subsequent observations of the species the following week directly across the border in Indiana prompted further exploration on the Illinois side. A targeted survey focused on *E. geniculata* was conducted on August 26 at both Big Marsh and the Illinois portion of State Line with the assistance of aspiring botanist Matteo C. Pilla.

The survey at State Line was on the small strip of the property that crosses into Illinois. Sixty tiny individual culms were observed in a wet swale west of a garbage dump pile. Thousands of additional individuals observed on the Indiana side of the property.

During the targeted survey at Big Marsh, two populations of *Eleocharis geniculata* were observed. The first consisted of approximately 46 culms where *Phragmites australis* was managed, and the second consisted of approximately 180 culms growing in gaps within thickets of *P. australis* on the wet edge of the slag barrens.

The scattered distribution, small stature, and potential for interannual variation in germination may have contributed to *Eleocharis geniculata* being previously overlooked at these sites. To comprehensively assess the distribution and abundance of *E. geniculata* in Illinois, targeted surveys are recommended in habitats with suitable ecological characteristics.

FIGURE 2: Achene of *Eleocharis geniculata* from collection at Marian Byrne. Photo by Nathanael J. Pilla.

Notably, the original discovery of *Eleocharis geniculata* in Michigan, Ontario, and three additional locations in Indiana all occurred in 1934 (Hermann 1935, Taylor 1935) during what was described by Cook et al. (2014) as the "the single most intense drought year of the last millennium." This raises the possibility of a link between the historical and recent (2023) droughts in the Chicago region and their influence on the germination of this species. While these environmental factors may influence the interannual dynamics of the seed bank in this annual species, more research should be done to understand the germination mechanisms of *E. geniculata*.

Diagnostic Characters. There are 67 species of *Eleocharis* recognized in North America north of Mexico excluding many unresolved taxa (Smith et al. 2002; Gibbons and McMullen 2019), twenty-three of which are documented in Illinois through a search of the Consortium of Midwest Herbaria (2024) portal. *Eleocharis geniculata* is distinct from other spike-rushes through the following combination of characters: tufted and lacking rhizomes; glossy-black achenes 0.5–1.0 mm long (Figure 2); two-sided, reddish-brown perianth bristles; two stigmas; somewhat conical tubercle; spikelet thicker than the culm; and tight summit of basal sheath (Rothrock 2009; MICHIGAN FLORA ONLINE 2013; Wilhelm and Rericha 2017).

Specimen Citations. ILLINOIS. COOK CO.: South Side, Chicago. 41.717354, –87.581361. Material collected at Marian R. Byrnes Park where it was scattered in water over 3 cm deep on slag flat stretching approximately 150 meters. Was dry until heavy rainfall over the weekend raised water depths. Charophytes were abundant in the area. Associated species: *Alisma subcordatum*, *Proserpinaca palustris*, *Schoenoplectus acutus*, *Typha* ×*glauca*. July 31, 2023, *Pilla NJP.2307.3115.* (ILLS).

ILLINOIS. COOK CO.: South Side, Chicago. 41.686903, –87.568266. Material collected at Big Marsh Park wetland. There were approximately forty-six individuals on the wet edge of slag prairie/marsh. Associated species: *Carex viridula*, *Cyperus acuminatus*, *Cyperus bipartitus*, *Cyperus squarrosa*, *Cyperus*

strigosus, *Leucospora multifidum*, and *Panicum virgatum*. August 26, 2023, *Pilla, Anastasio, & Pilla NJP.2308.2604.* (ILLS).

ILLINOIS. COOK CO.: South Side, Chicago. 41.652241, –87.524943. Material collected at 3300 and State Line Slag Prairie in wet swale right on the Illinois side of the property. There were approximately sixty tiny individuals observed on the Illinois side with thousands on the Indiana side where the water has dropped. Associated species: *Carex viridula*, *Euthamia graminifolia*, *Frangula alnus*, *Lycopus uniflorus*, *Lythrum salicaria*, *Panicum virgatum, Phragmites australis*, *Solidago gigantea*, *Sporobolus vaginiflorus*. August 26, 2023, *Pilla, Anastasio, & Pilla NJP.2308.2607.* (ILLS).

AUTHOR CONTRIBUTIONS

NJP and AA collectively engaged in the fieldwork survey for *Eleocharis geniculata* within the Calumet Slag Barrens. NJP primarily drafted the botanical sections of the report while AA focused on the ecological components. Both authors contributed to the overall manuscript structure and revisions.

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BOOK REVIEW

Emily B. Sessa, *Ferns, Spikemosses, Clubmosses, and Quillworts of Eastern North America*. Princeton University Press, Princeton, New Jersey. 527 pp. paperback (flexibound) $29.95. ISBN 978-0-691-21945-5; e-book $20.97. ISBN 978-0-691-22044-4.

Certain groups of plants that have a special interest for nature enthusiasts and professionals alike often engender special guidebooks, unlike the majority of plants that are treated only in more general floras or popular guides. These special groups include taxonomic groupings such as orchids, growth form groupings such as trees and/or shrubs, or even those that fall into both categories, such as graminoids (grasses, sedges, and rushes or sometimes just grasses or sedges alone). Prominent among the subjects of such specialized guidebooks are the pteridophytes, more commonly referred to as ferns and lycophytes (or, in older guides, "ferns and fern allies"). In eastern North America, numerous pteridophyte guides cover a particular state or national park. Examples include Louisiana (Thieret 1980), Michigan (Palmer 2018), Kentucky (Cranfill 1980), Great Smoky Mountains National Park (Evans 2005), Minnesota (Smith 2023), and many others. Cobb (2005) covers a larger area—northeastern and central North America. For those wishing a single volume covering the ferns of a broader area, within the last few decades two works covered all the then known species of pteridophytes in North America north of Mexico. The first of these (Mickel 1979) was a semi-popular guide that provided identification keys, useful line drawings, and very brief descriptions of all species. More recently, and geared to a more professional audience, Smith and Wagner (1993) provided a comprehensive treatment of pteridophytes of North America north of Mexico as the first published volume (other than an introductory volume) in the Flora of North America project. Moran (2004) also provides a delightful general natural history of ferns on a world-wide basis without purporting to be a floristic guidebook or classification.

Since most of the works cited here were published, the pteridophytes have undergone dramatic revisions to their classification. Perhaps the most radical to those who first learned about plants more than a couple of decades ago has been the recognition that two groups once thought to be among the most primitive extant vascular plants and formerly included among the "fern allies"—the whisk-ferns (*Psilotum*)[1] and the horsetails (*Equisetum*)—should actually be classified among the true ferns (Pryer et al. 2004). Since the remaining groups formerly encompassed within the "fern allies," the families Lycopodiaceae (clubmosses), Isoetaceae (quillworts), and Selaginellaceae (spikemosses), form a monophyletic

[1]*Psilotum* is in the family Psilotaceae, which also includes the extra-territorial genus *Tmesipteris*.

clade that separates at the base of the clade that includes all other vascular plants, the ferns and the seed plants, they are now generally considered to be a separate group referred to collectively as lycophytes. But even within the ferns themselves, there have been many recent taxonomic adjustments, including changes to family and generic circumscriptions, with concomitant changes in the names of some species. Following in the footsteps of Smith et al. (2006), Christenhusz et al. (2011), and Christenhusz and Chase (2014), the generally accepted current classification of lycophytes and ferns is presented by the Pteridophyte Phylogeny Group (PPG 2016).

Emily Sessa has now given us a magnificent field guide to all of the pteridophytes of eastern North America that for the first time employs this most recent classification. The coverage includes the entire eastern United States east of the Mississippi River and contiguous portions of Canada, not including Newfoundland, Labrador, and northern Quebec. Dr. Sessa, who received her doctorate at the University of Wisconsin-Madison, is an expert in the ecology and evolution of ferns and lycophytes, especially of eastern North America and Africa, at the New York Botanical Garden, where she is also the Director of the Herbarium, one of the largest in the world.

The introductory material of the book contains a valuable discussion of the biology of these interesting plants, including detailed discussions of morphology and identification, as well as a brief discussion of the life cycles of these plants and their evolution, especially hybridization and reticulate evolution, which is a common feature of several genera represented in eastern North America. There is also an extensive glossary of technical terms.

The main part of the book, which contains treatments of the individual genera and species, is arranged first in two major sections—Lycophytes and Ferns—then, within each of these major sections, alphabetically by genus. Within each generic treatment, the species are arranged alphabetically. A key to genera is provided at the outset. Families are downplayed, however. There is no key to families, family descriptions are absent, and the genera are not grouped by family. The treatment of each genus indicates the family to which it belongs and incudes one or two informative paragraphs. If there is more than one species in the genus, there will be a key to species as well as comparative side-by-side photographs of the fronds and/or other distinguishing characters. Genera with extensive hybridization or reticulate evolution based on ancient hybridization, such as *Dryopteris* or *Asplenium*, are provided with explanations and a useful chart of the complex relationships among the species. Each species is treated on a single page that includes the scientific name, one or more common names, a statement of whether it is native or introduced and its frequency of occurrence, a brief statement of its habitat and distribution, and a distribution map. In addition, a detailed description is provided along with several photographs showing the overall habit as well as critical identifying characters. Most of the photographs are by the author, though a few are credited to others.

At the end of the book is a checklist of all species in the book indicating the presence of each in one or more of the four main geographical areas—Florida, South, Central, and North (these are also indicated in each species treatment). There is also a useful list of general references, relevant scientific papers, and

web-based resources. Finally, an index to scientific names, including synonyms, will be particularly useful to many users who are familiar with names that have only recently been displaced by generic splitting, such as in *Woodsia*/*Physematium*, or *Osmunda*/*Claytosmunda*, among others, that would otherwise be difficult to find by those unfamiliar with the newer names.

A few sophisticated users may be disappointed by the lack of author citations for the scientific names and perhaps by the presence of fewer synonyms than one might like. But such users have ready access to other resources for this information. Somewhat more troublesome is the fact that while most of the distribution maps are reasonably accurate, a few seem to have serious discrepancies. Some (e.g., *Adiantum capillus-veneris*, *Cystopteris fragilis*) show a distribution covering significantly larger territory than can be found in other sources. Others (e.g., *Asplenium montanum*) do not include all areas where the species is known.

Despite these few shortcomings, Emily Sessa's book is a superb guide to the ferns and lycophytes of eastern North America. It contains a wealth of information about each species and genus occurring in this large area; it provides excellent tools for identification in the form of well-written keys, full descriptions, and detailed illustrations; and, for the first time, it provides a useful guide to the ferns and lycophytes of this entire region that employs the most recent classification and nomenclature. It can be used with confidence by anyone seeking to learn more about these fascinating plants or who simply wants to learn the identity of a particular specimen found in the field. We can only hope that a similar volume covering the species of western North America will appear before too long.

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——Michael Huft
mhuft@att.net